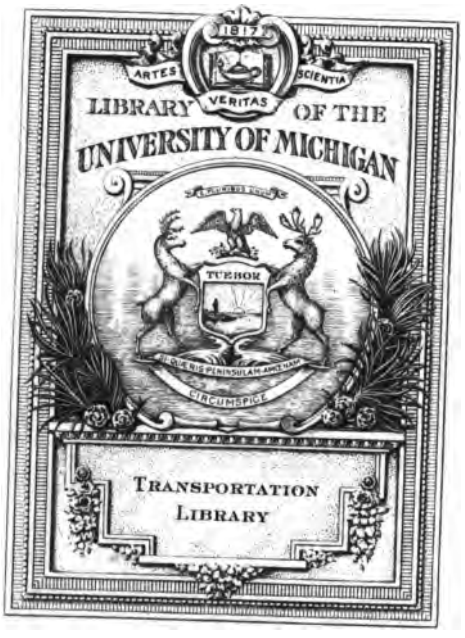
ANNUAL REPORT

OF THE

DIRECTOR OF MILITARY AERONAUTICS

U. S. ARMY

1918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ANNUAL REPORTS, WAR DEPARTMENT

FISCAL YEAR ENDED JUNE 30, 1918

REPORT OF THE

DIRECTOR OF MILITARY AERONAUTICS

U. S. ARMY

TO THE SECRETARY OF WAR

1918

WASHINGTON
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REPORT OF THE DIRECTOR OF MILITARY AERONAUTICS.

WAR DEPARTMENT,
OFFICE OF THE DIRECTOR OF MILITARY AERONAUTICS,
November 3, 1918.

SIR: I have the honor to submit herewith the annual report of the Division of Military Aeronautics for the fiscal year ended June 30, 1918. Though the Division of Military Aeronautics was created only on April 24, 1918, it was agreed that the duties intrusted to it and previously carried out by the Signal Corps should be covered in this report in order to present a continuous story of the development of the personnel, training, and organizing phases of the present Air Service. Also it should be pointed out that operations on the front in France have been left largely to whatever report the American Expeditionary Force may deem wise.

The fiscal year 1917–18 saw aviation develop from a wholly subsidiary branch of the Army as the Aviation Section of the Signal Corps to a position of extreme and decisive importance as the Air Service, directly under the Chief of Staff. From the most insignificant beginnings it came within the year to be one of America's major efforts in the war.

This is all the more surprising when America's previous backwardness in aviation is considered. This country has stood practically still in aerial progress, while the war in Europe brought about an extraordinary advance. From all this the United States was entirely shut off up to the time it abandoned neutrality. So little exact knowledge was available that the first American planes to go with the expedition into Mexico in March, 1916, were all rendered useless in accidents within a short time of arrival. There was practically no aviation technique here comparable to Europe's, almost negligible manufacturing facilities, not a hundred trained flyers, and only the most rudimentary facilities for training. Moreover, no one had any adequate appreciation of the intricacy and skill required in the making of either an airplane or the training of a pilot.

As against this stagnation Europe's progress in two and one-half years of war had been tremendous. The first planes to go to the front in 1914 had been few in number, unequipped with radio, machine guns, bombs, or photographic apparatus, and entirely unproved in military value. Their extraordinary success, however, in disclosing the size of the German concentration in Belgium at once brought them into a position of great importance. Very shortly radio was installed to replace signaling by dropping tinsel or making curious evolutions; the pistols of the pilots gave way to machine guns; the easy-going system of dropping bombs over the side was replaced by regular bombing planes, and the occasional taking of photographs by an intricate system of picturing every mile of the front. Engine power increased to 200, 300, 400, 500 horsepower; huge planes with large carrying capacity were being developed for night bombing; and operations were taking place by whole squadrons in various air strata—light, single-seater scouts around 15,000 to 20,000 feet, two-

seater day bombers around 9,000 feet, and photographic and observation planes around 6,000 feet.

In contrast to all this development the United States at the time of its entry into the war stood very little ahead of where it had been before the world war broke out. Aviation, both in its personnel and its equipment, was included in that part of the Signal Corps known as the Aviation Section, which had been established by Congress July 18, 1914. Its chief was Maj. Gen. George O. Squier, who after four years as military attaché in London, had been put in charge of the Aviation Section in May, 1916, and made Chief Signal Officer on February 14, 1917, continuing to have charge of aviation through nearly the whole of the fiscal year. On April 6, 1917, the total assets on hand consisted of 65 officers, 1,120 men, two small flying fields, less than 300 very second-rate training planes, practically no manufacturing facilities, and only the most meager technical information as to Europe's startling developments.

The original American war program, based on an army of a million men, made aviation but a relatively insignificant part of the general military forces. This program, which represented the view of the General Staff before the arrival of the foreign missions, was met by two appropriations, $10,800,000 on May 12, 1917, and $43,450,000 on June 15, many times larger than any apropriations ever before made.

The British and French missions, however, arriving the last part of April, completely revolutionized this viewpoint. Supported by an urgent cable of May 24 from the premier of France, calling for 2,000 planes a month and a total of 5,000 pilots and 50,000 mechanicians, the $640,000,000 appropriation, the largest ever made by Congress for one specific purpose, was drawn up, put through the House of Representatives Military Affairs Committee in two meetings, the House itself in one, the Senate Military Affairs Committee in 45 minutes, and the Senate itself a week later, becoming law on July 24, 1917. On this date the present large program was really launched, two months and a half after the outbreak of war, and largely in response to allied appeals.

The rest of the fiscal year was taken up in amplifying and executing the lines of effort here laid down. Toward the end of the year, however, it became obvious that the system of organization of an Aviation Section as a subsidiary branch of the Signal Corps was not functioning efficiently. The British and French, perceiving that we were encountering the same kind of obstacles as theirs, strongly recommended a separate, independent air service similar to the air ministries they had been obliged to established and which have worked so successfully since. As a result, a first step was taken in a rearrangement of duties designed to effect a greater independence and a greater concentration of authority when, on April 24, the War Department authorized the following statement:

Mr. John D. Ryan has accepted the directorship of aircraft production for the Army.

A reorganization of the Aviation Section of the Signal Corps has been also effected, of which the principal elements are as follows:

Gen. Squier, as Chief Signal Officer, will devote his attention to the administration of signals; a Division of Military Aeronautics is created, under the direction of Brig. Gen. William L. Kenly. The Aircraft Board, created by act of Congress, remains an advisory body, as it has been in the past, with Mr. Ryan as its chairman. This arrangement is made with the entire concurrence of Mr. Howard Coffin, who remains a member of the Advisory Commission of

the Council of National Defense and will render assistance and counsel to the Aircraft Board and Mr. Ryan.

The Division of Military Aeronautics will have control of the training of aviators and military use of aircraft. The exact division of functions in the matter of designing and engineering will be worked out as experience determines between the Division of Military Aeronautics and the Division of Production.

This announcement involves no change of personnel in the present Equipment Division of the Signal Corps, of which W. C. Potter is chief, and which will continue under his direction.

This reorganization, however, was admittedly but the first step. The first action taken by the President under the broad powers of the Overman Act was to effect a still further reorganization by taking aviation entirely out of the jurisdiction of the Signal Corps, where it has been from its inception on July 18, 1914, and to set up two separate bureaus, one for securing and training the large flying and ground forces and the other for providing planes, engines, and equipment.

The presidential order of May 21 covering this change follows:

By virtue of the authority in me vested as Commander in Chief of the Army and by virtue of further authority upon me specifically conferred by "An act authorizing the President to coordinate or consolidate executive bureaus, agencies, and offices, and for other purposes, in the interest of economy and the more efficient concentration of the Government," approved May 20, 1918, I do hereby make and publish the following order:

The powers heretofore conferred by law or by Executive order upon and the duties and functions heretofore performed by the Chief Signal Officer of the Army are hereby redistributed as follows:

I.

(1) The Chief Signal Officer of the Army shall have charge, under the direction of the Secretary of War, of all military signal duties, and of books, papers, and devices connected therewith, including telegraph and telephone apparatus and the necessary meteorological instruments for use on target ranges, and other military uses; the construction, repair, and operation of military telegraph lines, and the duty of collecting and transmitting information for the Army by telegraph or otherwise, and all other duties usually pertaining to military signaling; and shall perform such other duties as now are or shall hereafter be devolved by law or by Executive order upon said Chief Signal Officer which are not connected with the Aviation Section of the Signal Corps or with the purchase, manufacture, maintenance, and production of aircraft, and which are not hereinafter conferred, in special or general terms, upon other officers or agencies.

(2) A Director of Military Aeronautics, selected and designated by the Commander in Chief of the Army, shall hereafter have charge, under the direction of the Secretary of War, of the Aviation Section of the Signal Corps of the Army, and as such shall be, and he hereby is, charged with the duty of operating and maintaining or supervising the operation and maintenance of all military aircraft, including balloons and airplanes, all appliances pertaining to said aircraft and signaling apparatus of any kind when installed on said aircraft, and of training officers, enlisted men, and candidates for aviation service in matters pertaining to military aviation, and shall hereafter perform each and every function heretofore imposed upon and performed by the Chief Signal Officer of the Army in, or in connection with, the Aviation Section of the Signal Corps, except such as pertains to the purchase, manufacture, and production of aircraft and aircraft equipment and as is not hereinafter conferred, in special or general terms, upon the Bureau of Aircraft Production; and all airplanes now in use or completed and on hand and all material and parts, and all machinery, tools, appliances, and equipment held for use for the maintenance thereof; all lands, buildings, repair shops, warehouses, and all other property, real, personal, or mixed, heretofore used by the Signal Corps in, or in connection with, the operation and maintenance of aircraft and the training of officers, enlisted men, and candidates for aviation service, or procured and now held for such use by or under the jurisdiction and control of the Signal Corps of the Army; all books, records, files, and office equipment heretofore used by

the Signal Corps in, or in connection with, such operation, maintenance, and training; and the entire personnel of the Signal Corps as at present assigned to, or engaged upon work in, or in connection with, such operation, maintenance, and training, is hereby transferred from the jurisdiction of the Chief Signal Office and placed under the jurisdiction of the Director of Military Aeronautics; it being the intent hereof to transfer from the jurisdiction of the Chief Signal Officer to the jurisdiction of the said Director of Military Aeronautics every function, power, and duty conferred and imposed upon said Director of Military Aeronautics by subparagraph (2) of paragraph I hereof all property of every sort of nature used or procured for use in, or in connection with, the functions of the Aviation Section of the Signal Corps placed in charge of the Director of Military Aeronautics by subparagraph (2) of paragraph I hereof, and the entire personnel of the Signal Corps in charge of the Director of Military Aeronautics by subparagraph (2) of paragraph I hereof.

(3) An executive agency, known as the Bureau of Aircraft Production, is hereby established, and said agency shall exercise full, complete, and exclusive jurisdiction and control over the production of airplanes, airplane engines, and aircraft equipment for the use of the Army, and to that end shall forthwith assume control and jurisdiction over all pending Government projects having to do or connected with the production of airplanes, airplane engines, and aircraft equipment for the Army and heretofore conducted by the Signal Corps of the Army, under the jurisdiction of the Chief Signal Officer; and all material on hand for such production, all unfinished airplanes and airplane engines, and all unfinished, unattached, or unassembled aircraft equipment; all lands, buildings, factories, warehouses, machinery, tools, and appliances, and all other property, real, personal, or mixed, heretofore used in or in connection with such production, or procured and now held for such use, by or under the jurisdiction and control of the Signal Corps of the Army; all books, records, files, and office equipment used by the said Signal Corps in or in connection with such production; all rights under contracts made by the Signal Corps in or in connection with such production; and the entire personnel of the Signal Corps as at present assigned to or engaged upon work in or in connection with such production are hereby transferred from the jurisdiction of the Signal Corps and placed under the jurisdiction of the Bureau of Aircraft Production, it being the intent hereof to transfer from the jurisdiction of the Signal Corps to the jurisdiction of the said Bureau of Aircraft Production every function, power, and duty connected with said production, all property of every sort or nature used or procured for use in or in connection with said production, all property of every sort or nature used or procured for use in or in connection with said production, and the entire personnel of the Signal Corps, as at present assigned to or engaged upon work in or in connection with such production.

Such person as shall at the time be chairman of the Aircraft Board created by the act of Congress approved October 1, 1917, shall also be the executive officer of said Bureau of Aircraft Production, and he shall be, and he hereby is, designated as Director of Aircraft Production, and he shall, under the direction of the Secretary of War, have charge of the activities, personnel, and properties of said bureau.

II.

All unexpended funds of appropriations heretofore made for the Signal Corps of the Army and already specifically allotted for use in connection with the functions of the Signal Service as defined and limited by subparagraph (1) of Paragraph I hereof shall be and remain under the jurisdiction of the Chief Signal Officer; all such funds already specifically allotted for use in connection with the functions of the Aviation Section of the Signal Corps as defined and limited by subparagraph (2) of Paragraph I hereof are hereby transferred to and placed under the jurisdiction of the Director of Military Aeronautics for the purpose of meeting the obligations and expenditures authorized by said section; all such funds already specifically allotted for use in connection with the functions hereby bestowed upon the Bureau of Aircraft Production, as defined and limited by subparagraph (3) of Paragraph I hereof, are hereby transferred to and placed under the jurisdiction of said Director of Aircraft Production for the purpose of meeting the obligations and expenditures authorized by said bureau in carrying out the duties and functions hereby transferred to and bestowed upon said bureau; and in so far as such funds have not been already specifically allotted to the different fields of activity of the Signal Corps as heretofore existing, they shall now be allotted by the Secretary of War in such proportions as shall to him seem best intended to meet the require-

ments of the respective fields of former activity of the Signal Corps and the intention of Congress when making said appropriations, and the funds so allotted by the Secretary of War to meet expenditures in the field of activity of the Aviation Section of the Signal Corps are hereby transferred to and placed under the jurisdiction of the Director of Military Aeronautics for the purpose of meeting the obligations and expenditures authorized by said section; and the funds so allotted by the Secretary of War to meet the expenditures in that part of the field of activity of the Signal Corps, which includes the functions hereby transferred to the Bureau of Aircraft Production, are hereby transferred to and placed under the jurisdiction of the Director of Aircraft Production for the purpose of meeting the obligations and expenditures authorized by said bureau.

III.

This order shall be and remain in full force and effect during the continuance of the present war and for six months after the termination thereof by the proclamation of the treaty of peace, or until theretofore amended, modified, or rescinded.

Under this order Mr. John D. Ryan continued as Director of Aircraft Production and Maj. Gen. William L. Kenly became Director of Military Aeronautics.

This division of responsibilities and functions gave a clearer conception of the unique duties of the Air Service in production of planes and training of pilots, and is significant, too, of the many tactical reasons which made it imperative for England and France to establish separate and independent air services.

The end of the fiscal year found this problem of higher organization one of the most important to be faced. An early defect discovered in the reorganization developed when there appeared to be inadequate liaison between the Bureau of Aircraft Production and the Division of Military Aeronautics. One was responsible for the production of planes, the other for their operation and military efficiency. The method of selecting a type to put into production and the final decision whether any plane produced was suitable for its military purpose or not, was undetermined. The situation of two sets of officials with equal authority in their respective fields of action, neither responsible to the other, at once demonstrated that neither could be held for the final production of an acceptable plane for the front. This was partially obviated by an agreement between the Division of Military Aeronautics and the Bureau of Aircraft Production that the types of plane to be put into production must first be mutually agreed upon, and that before a plane could be sent to the front it should be given a military test and accepted by the Division of Military Aeronautics. But considerable time was lost before this policy was definitely arranged, a policy which might easily have at once been established by a unified department.

The personnel side of the air service, including the selection, training, organization, and operation of the flying forces, developed within the fiscal year 1917–18 into an educational system on a scale infinitely larger and more diverse than anyone had anticipated. Teaching men to fly, to send messages by wireless, to operate machine guns in the air, to know artillery fire by its bursts, and to travel hundreds of miles by compass, teaching other men to read the enemy's strategy from aerial photographs, and still others to repair instruments, ignition systems, propellers, airplane wings, and motors, has required a network of flying fields and schools, a large instructional force, and a maze of equipment and curricula.

None of this, practically speaking, was on hand at the outbreak of the war, neither fields, instructors, curricula, nor, more serious than all, experience to show what was to be needed. This country had never trained an aviator sufficiently to meet the demands of overseas aerial warfare and had not the slightest knowledge of the instruction necessary for radio, photography, or enlisted personnel. Consequently, the first men largely taught themselves before teaching others, and experience led on from one course to the next.

First, in the point of need, was that of flying fields. Two were in limited operation at the outbreak of war, San Diego and Mineola; three more were selected, cleared, equipped, and made ready for flying in six weeks' time, and by the end of the year over a score were in operation all over the country. All were protected by a three-year lease with option to buy, if desired, at a fixed price. During the year also five supply depots, three concentration depots, three balloon camps, two repair depots, one experimental field, one radio laboratory, and one quarantine camp were built.

The selection of men for training as flyers was a complicated task, as the requirements were necessarily rigid. Volunteer examining boards of the highest medical skill were organized all over the country, 36 urban and 30 divisional boards, and a total of 38,777 men were examined to June 2, of whom nearly half, or 18,004, were disqualified. This naturally led to a high grade of personnel, and made the later training both more rapid and more efficient.

The first step in instruction was at one of the new "ground" schools opened on May 21 at the Massachusetts Institute of Technology, Cornell and Ohio State Universities and the Universities of Illinois, Texas, and California, with Princeton and the Georgia School of Technology added on July 5. Here, in eight weeks, under military discipline, the cadets were grounded in all the elements of aviation at a cost to the Government at first of $65 per pupil, and later $10 each for the first four weeks, and $5 weekly thereafter. By June 30, 1918, a total of 11,539 men were graduated to the flying fields and 3,129 were discharged for failure in studies, etc.

Next came the actual flying instruction, divided into two phases, primary and advanced. The former averaged about eight weeks, included ability to execute the simpler evolutions and cross country flights, and led to an officer's commission and the right to wear the Reserve Military Aviator's wings. To June 30, 1918, 4,980 men had been graduated as Reserve Military Aviators for final training, and about 400 had been disqualified as incapable of becoming fliers.

The advanced training, however, presented infinitely more difficulties. It was not nearly so simple to teach the more complex stunts, formation flying, aerial machine gunnery, bombing, and night flying, while at the same time the highly specialized equipment necessary required considerable time for manufacture. Nevertheless, advanced schools of the three types necessary were opened toward the end of the year 1918, with what equipment was available, and had graduated 110 bombers, 85 bombing pilots, 464 observers, 389 observer pilots, and 131 pursuit pilots by June 30, 1918.

The ideal arrangement in mind at the end of the year was to train each pilot completely on this side of the ocean, where facilities are very good, supplies in abundance, and information and experienced pilots from the front available in ever-increasing numbers. The

fliers can then be organized into provisional squadrons and wings and given training as large units with their own administrative officers and enlisted personnel so that they will be able to go immediately to the front, after a month or so of transformation work in France, learning geography and familiarizing themselves with new types of planes. Plans are under way looking to the establishment of such wings and brigades in the United States with the end in view of furnishing complete and fully trained units to the American Expeditionary Force.

The whole training program was considerably held up by lack of equipment. Obviously it required far less time to select men for training than to build the fields, planes, and accessories necessary to train them. Primary training planes, the only type manufactured here before the war, soon become available in increasing numbers, till by the end of the year more were on hand than needed. The advanced training planes, however, presented problems wholly new to this country, so that primary planes had to be fitted with more powerful engines and equipment and made to serve the purpose. The first 16 single-seater pursuit planes were not delivered till January, 1918, the first bombers till March, and the first gunnery late in May.

During this fiscal year a grand total of 407,999 hours were flown by Army aviators in the United States, as contrasted with 745.5 hours in 1914 and 1,269 in 1915. In the single week ending June 30, 1918, a total of 19,560 hours were flown, or 15 times, for that single week, the number for the whole year three years before. This, at 75 miles an hour, is equivalent to over 30,000,000 miles, or 1,223 times around the Equator.

During it there were 152 fatalities, or 2,684 flying hours and 201,000 miles flown to each death. Of these, 86 were caused by stalls, when the plane, usually through some error by the pilot, lost its flying speed and dropped into a straight nose dive or turned into a tail spin, from which the pilot did not have the time or the skill to extricate it. Collisions were responsible for 30 other accidents, often due to failure to fly according to the rules. Side-slips, the only other large cause of accidents, resulted in 10 deaths.

Regrettable as these accidents are, it is felt that, considering the newness of the science, the early state of development of the planes, the inexperience in instruction, and the necessity of teaching stunts in themselves rather dangerous, this number is not large. As a matter of actual statistics, fatalities in American training are less than half as large as those of the other allied countries.

Besides flyers, however, engineer officers to direct the upkeep of the equipment, supply officers to keep sufficient equipment on hand, and adjutants to keep the records and do other military work had to be especially trained. These men, absolutely essential to the maintenance of the Air Service organization, could be secured only after a detailed course of instruction. An engineers' school, opened for a 12 weeks' course at the Massachusetts Institute of Technology on January 12, graduated 590 men and discharged 228 before June 30; a supply officers' school, opened at the Georgia School of Technology, graduated 852 men and discharged 111 from an eight weeks' course before it was closed on May 11; and an adjutants' school, opened at Ohio State University on January 12, graduated 789 and discharged 97 men in an eight weeks' course before it was closed June 22.

A six weeks' course for armament officers and men to care for machine guns and bombs was opened at Fairfield, Ohio, on April 22, graduating 95 officers and 465 men by June 30, all of whom went forthwith overseas. Just at the end of the year a series of special schools in aerial gunnery were opened as the final step in the flyers' training in this country, graduating 102 pilots, 111 observers, and 101 fighting observers by June 30. Also a special course for compass officers was opened at Camp Dick, Tex., on April 10, with 53 graduates, and another course at the same time for a score of navigation officers.

Radio also required very special instruction, with courses and instructors for all flyers through the various stages of their progress, for the receiving force on the ground, and for the men responsible for the upkeep of the radio equipment. At the outset, volunteer civilians, each with his own methods of instruction, stepped into the breach, but by the end of the year two radio officers' and four enlisted men's schools were in operation with 49 and 329 graduates, respectively; radio officers and equipment had been sent to every field and ground school; and the courses for flyers had been standardized all the way through.

Aerial photography, which had developed during the war into an exact science, required similar triple instruction—that for observers to operate the cameras in the air, intelligence officers on the ground to interpret them, and enlisted men to aid in the developing, printing, and enlarging, and to keep the equipment in condition. Where the United States had not even a single aerial camera at the outbreak of the war, by the end of the year there had been opened on March 25 a large school for developers and printers at Rochester, N. Y., with 680 graduates by June 30, an officers' school on January 6 at Cornell teaching map compilation and interpretation, and photographic "huts" with complete personnel and equipment for instruction at each of the flying fields.

One of the most serious problems, and one of late development, was that of enlisted men, the ground force needed to keep the planes and engines always in prime condition, repair minor breaks, tighten up wires, strengthen struts, and make sure that no airman went up in a faulty plane. This was work wholly new to American mechanics, and of a delicacy and carefulness to which they were quite unaccustomed. Moreover, mechanics of the skill required had largely been drained off by the draft, by enlistment, or by other war industries.

Consequently, a whole series of schools was necessary. At first, in the fall small detachments of mechanics were sent to various factories—ignition, magneto, propeller, welding, instruments, sail-making, cabinet work, copper work, machine guns, and motors to secure as much experience as possible. While about 2,000 men were being graduated from 17 courses at 34 different schools of this type, more fully worked out courses were established at five northern flying fields closed for flying during the winter. With 2,500 graduated here, still more detailed courses were opened at four large mechanics' schools, which added another 5,000 men. By the end of the year two large and complete Government schools were in operation at Kelly Field, Tex., and St. Paul, Minn., capable of graduating 5,000 men every three months.

A noteworthy event of the year was the opening on May 15 of the first regular aerial mail service in the United States between New York, Philadelphia, and Washington. The Army furnished six planes and pilots, shortly doubled, for a daily round trip, carrying about 350 pounds of mail each way, and with a record of 50 minutes for the 90 miles between Philadelphia and New York, and 1 hour and 50 minutes for the 135 miles from Philadelphia to Washington. Ninety per cent of the trips were made successfully.

Another vitally important phase of the Air Service is that of ballooning, which during the war has been developing into a system of ever-watchful sentries on guard all the way from the North Sea to Switzerland. Less spectacular, perhaps, than the heavier-than-air work, this branch of the service has a quite indispensible function. The observer, swinging in a captive balloon at an altitude of a mile, 2 to 5 miles from the enemy's lines, and with a range of vision of 8 miles in all directions, can make a far more detailed, minute-by-minute analysis of the enemy's movements than the wider visioned but transitory aviator, and can maintain such a flow of minute information to the staff below that no important movement can take place unobserved within his view.

Here, also, at the outbreak of the war the United States was practically without facilities. The only school was at Fort Omaha, Nebr., recovered from complete abandonment the previous November, with accommodations for 15 officers and 400 men, and equipment of balloon shed, gas plant, two obsolete captive balloons, and some telephone material. The original program of August 13 necessitated a very large expansion, fully comparable to that in the heavier-than-air branch.

To meet the program the Fort Omaha school was enlarged in September to accommodate 61 officers and 1,200 men; on December 28 Camp John Wise was opened at San Antonio with a final capacity of 150 officers and 2,200 men, and special companies were sent to Fort Sill, Okla., for cooperation with the Coast Artillery. By June 30, 440 balloon officers had graduated, of whom 155 were fully qualified observers, and 73 had been sent overseas. The enlisted strength stood at 9,621 with 1,382 abroad.

Thus, by the end of the fiscal year, the Air Service had in operation an educational system complete in all the details necessary to man this intricate service. Fields, curricula, instructors, and equipment were on hand for the most diverse courses, and men were graduating in hundreds trained to all the difficulties of operating airplanes, and translating their work into effective action. A total of 34,209 men had been graduated from the various courses, with 20,976 men enrolled in 50 schools of 16 different types.

Many outside bodies were called upon to cooperate in this development. Great Britain, France, and Italy all early established large aviation missions in Washington which brought their three years of experience to help solve problems confronted here for the first time. The National Advisory Committee for Aeronautics, the Bureau of Standards, and several joint Army and Navy Boards also added their information on the subject.

Nevertheless the work was carried out under extreme difficulties. Operation and production were not properly coordinated. Much time was lost in having to obtain the necessary authority to build